

KEYS TO THE GENERA, AND TO THE SPECIES OF  
FIVE MINOR GENERA, OF MOSQUITO PUPAE OCCURRING IN THE  
NEARCTIC REGION (Diptera, Culicidae)

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**ABSTRACT.** A generic key to the mosquito pupae of the 13 genera occurring in the Nearctic Region is presented. In addition, specific keys to the pupae of the Nearctic species of *Deinocerites*, *Mansonia*, *Orthopodomyia*, *Uranotaenia* and *Wyeomyia* are included. A total of 15 species are incorporated in these 5 pupal keys.

**INTRODUCTION.** Of the postovarian stages in the mosquito life cycle, the pupal stage continues to be the least utilized for identification in the Nearctic Region. The study of pupae in the Region was started by Darsie (1949, 1950) with the description of 39 species. Since then many pupae of the 168 species known in the Region have been described or incorporated into identification keys. The genera for which keys have been produced include *Anopheles* by Penn (1949b), *Culiseta* by Barr (1963), *Mansonia* by Kutz and Darsie (1963), and *Psorophora* by Barr and Barr (1969). In addition, Nearctic species have been incorporated into generic, subgeneric or country monographs by Foote (1954, genus *Culex*, subgenus *Melanoconion*), by Zavortink (1968, genus *Orthopodomyia*), by Adames (1971, genus *Deinocerites*) and Belkin et al. (1970, for the country of Jamaica). The last reference includes pupal keys to all the genera occurring in that country, most of which contain species found in the Nearctic Region. The purpose of this paper is to construct keys not only for the 13 genera of the Region but also for the Nearctic species of 5 minor genera. They were composed by modifying keys in the generic monographs by Zavortink (1968) and Adames (1971) and from Belkin et al. (loc. cit.); but also by studying descriptions of pupae not previously placed in keys and by examining specimens of an undescribed pupa.

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One difficulty encountered in the study of mosquito pupae is the plethora of nomenclatures used to designate the setae on the pupal body. The setae are used extensively in identification keys.

Those employed by Knight and Chamberlain (1948), Penn (1949) and Darsie (1949, 1950) have been discarded in favor of that proposed by Belkin (1952, 1953). Its advantages are that the pupal setae are homologized with the larval setae (Belkin, 1951), and that the same numbering system is used for both stages. The keys presented here utilize Belkin's nomenclature. It will be best understood if the reader substitutes the descriptions and figures in Belkin (1952, 1953) and Belkin et al. (1970) for the chaetotaxical systems used prior to Belkin's work.

Another helpful reference is Harbach and Knight (1980). They present a glossary and illustrations of mosquito pupal morphology (pp. 276-307). Tables 16-23 give comparisons of the various terminologies of pupal setae which have been employed since 1920.

**GENERIC KEY.** Generic keys have been written for the mosquito pupae which pertain to parts of the Nearctic Region, but not for the Region as a whole. Knight and Wonio (1969) included genera occurring in Iowa, Bohart and Washino (1978), in California, Means (1979), in New York, Darsie (1950), in the northeastern United States, Darsie (1982), in the New World and Mattingly (1971), for all genera known in the family Culicidae, worldwide. Another pupal key of note is that for Jamaica (Belkin et al., 1970) since it contains many of the Nearctic genera.

The following generic key for pupae includes just those 13 genera found in the Nearctic fauna. Since only 1 species is known for the genera *Coquillettidia*, *Haemagogus* in the target region, generic characters can be used to identify pupae of *Cq. perturbans* (Walker) and *Hg. equinus* Theobald.

#### KEY TO THE PUPAE OF THE NEARCTIC GENERA OF CULICIDAE

1. Setae 9-III-VII stout, spiniform, placed at posterior lateral corners of segment (subfamily Anophelinae).....*Anopheles*  
 Setae 9-III-VI minute to small, seta 9-VII medium to large, hair-like, placed somewhat anterior to posterior lateral corners.....2

- 2(1). Seta 1-X present on genital pouch; paddle with posterior prolongation of portion lateral to midrib (subfamily Toxorhynchitinae).....*Toxorhynchites*  
Genital pouch without seta 1-X; paddle without posterior prolongation lateral to midrib (subfamily Culicinae).....3
- 3(2). Trumpet with distinct tracheoid pattern present in 0.2 to 0.9 of meatus.....4  
Trumpet meatus without tracheoid pattern or with patch near base.....8
- 4(3). Trumpet attenuated apically, without pinna, fitted for piercing plant tissue.....5  
Trumpet with distinct pinna and usually widening apically.....6
- 5(4). Setae 1 and 5 on abdominal segments III-VII long and stout.....*Mansonia*  
Setae 1 and 5 on III-VII short and thin.....  
.....*Coquillettidia perturbans*
- 6(4). Seta 1-P at least 0.9 length of paddle; seta 9-VIII long, longer than tergum VIII, single.....*Deinocerites*  
Seta 1-P no more than 0.2 length of paddle; seta 9-VIII shorter, not as long as tergum VIII, branched.....7
- 7(6). Seta 8-C closer to base of trumpet than to seta 9-C; paddle unequally divided by midrib, larger and lobe-like medially.....*Uranotaenia*  
Seta 8-C closer to seta 9-C than to base of trumpet; paddle divided more or less equally by midrib, or larger part lateral to midrib.....*Culex*
- 8(3). Setae 9-VII, VIII large, with numerous branches; paddle without apical seta.....*Wyeomyia*  
Seta 9-VII rarely subequal to seta 9-VIII, if so, with fewer branches; paddle with at least seta 1-P or 1,2-P.....9
- 9(8). Seta 8-C attached almost directly posterior to seta 9-C; paddle without infuscation along external buttress and apex.....10  
Seta 8-C attached somewhat dorsal to seta 9-C, if 8-C is posterior to 9-C, then paddle with marked infuscation.....11

- 10(9). Abdominal segment VIII not markedly smaller basally, VII and VIII appear fused; seta 1-VI mesad of seta 2,3-VI.....*Orthopodomyia*  
 Abdominal segment VIII smaller basally, VII and VIII appear as distinctly separate; seta 1-VI laterad of setae 2,3-VI.....*Culiseta*
- 11(9). Seta 5-II mostly mesad to seta 4-II; seta 2-P sometimes present; abdominal segment IV sometimes with denticles at posterolateral corners; paddle sometimes with infuscation.....*Psorophora*  
 Seta 5-II usually laterad to seta 4-II; seta 2-P absent; abdominal segment IV without denticles posterolaterally; paddle without infuscation.....12
- 12(11). Midrib of paddle strong, reaching apex; setae 5-II,III short, not reaching posterior border of segment, single.....*Haemagogus*  
 Midrib of paddle weak, not reaching apex; setae 5-II,III longer, exceeding posterior border of segment, usually with 2 or more branches.....*Aedes*

**KEYS TO PUPAE OF SOME NEARCTIC GENERA.** Sufficient work has been published on descriptions of mosquito pupae of *Deinocerites* Theobald by Adames (1971), *Mansonia* Blanchard by Kutz and Darsie (1963) and Belkin et al. (1970), *Orthopodomyia* Theobald by Zavortink (1968), *Uranotaenia* Lynch Arribalzaga by Darsie (1950), Belkin and McDonald (1956) and Belkin et al. (1970) and *Wyeomyia* Theobald by Darsie (1950) and Belkin et al. (1970) to complete keys for the Nearctic species. The pupa of *Wy. haynei* Dodge is undescribed but 5 pupal pelts were used to formulate the key. Its complete description is in preparation.

**KEY TO THE PUPAE OF THE GENUS *DEINOCERITES*  
 OF THE NEARCTIC REGION<sup>1</sup>**

1. Seta 1-VII longer than following tergum, extending to middle of seta 4-VIII; seta 7-C usually 4,5-branched; seta 5-III longer than following tergum, usually triple....*mathesoni* Belkin and Hogue

<sup>1</sup>Modified from Adames (1971).

- Seta 1-VII usually no longer than following tergum, if longer, extending only to basal 0.33 of seta 4-VIII; seta 7-C usually double or triple; seta 5-III longer than following tergum, mostly simple.....2
- 2(1).     Setae 10-C and 8-C double; seta 6-I less than 1.5 times length of seta 7-I.....*cancer* Theobald  
           Seta 10-C multibranching, resembling float hair; seta 8-C single; seta 6-I at least 3.0 times length of seta 7-I.....*pseudus* Dyar and Knab

KEY TO THE PUPAE OF GENUS *MANSONIA*  
 IN THE NEARCTIC REGION<sup>1</sup>

1.     Trumpet short, index<sup>2</sup> 6.0 or less; paddle moderately broad, index<sup>3</sup> 2.5 or less; seta 1-II strong, long, longer than following tergum.....*titillans* (Walker)  
        Trumpet long, index about 10.0; paddle narrow, index about 3.5; seta 1-II weak, short, not as long as following tergum.....  
        .....*dyari* Belkin, Heinemann and Page

KEY TO THE PUPAE OF THE GENUS *ORTHOPODOMYLA*  
 IN THE NEARCTIC REGION<sup>4</sup>

1.     Paddle with minute, submarginal spicules in posterior portion of inner margin; setae 5-IV,V extending to near apical margin of following tergum; seta 11-C much longer than seta 10-C.....*kummi* Edwards  
        Paddle without such minute spicules; setae 5-IV,V usually not extending to near caudal margin of following tergum; seta 11-C subequal to or only slightly longer than seta 10-C.....2

<sup>1</sup>Adapted from Kutz and Darsie (1963) and Belkin, Heinemann and Page (1970).

<sup>2</sup>Trumpet index is the length divided by the width at the middle.

<sup>3</sup>Paddle index is the length divided by the greatest width.

<sup>4</sup>Modified from Zavortink (1968).

- 2(1).     Setae 2-II-VI 0.4-0.6 length of seta 1 of same  
           segment; setae 6,7-I no longer than seta 4-I;  
           setae 5-III longer and stronger than seta  
           3-III.....*alba* Baker  
           Setae 2-II-VI less than 0.3 length of seta 1 of  
           same segment; setae 6,7-I much longer than seta  
           4-I; setae 5-III weaker and shorter than seta  
           3-III.....*signifera* (Coquillett)

KEY TO THE PUPAE OF THE GENUS *URANOTAENIA*  
 IN THE NEARCTIC REGION<sup>1</sup>

1.         Seta 11-C usually single; seta 6-II shorter than  
           following tergum; pinna of trumpet long, meatus  
           without slit.....*lowii* Theobald  
           Seta 11-C usually at least 3-branched; seta 6-II  
           longer than following tergum; pinna of trumpet  
           short, continuing into meatus as long, narrow  
           slit.....2
- 2(1).     Setae 10,11-C with at least some branches subequal  
           in length, others shorter; seta 1-VII shorter  
           than following tergum.....*sapphirina* (Osten Sacken)  
           Seta 10-C distinctly longer than seta 11-C; seta 1-  
           VII as long as following tergum.....3
- 3(2).     Trumpet flared at apex; seta 12-C usually with 6 or  
           more branches.....*a. anhydor* Dyar  
           Trumpet gradually widening apically; seta 12-C  
           usually with 5 or fewer branches.....  
           .....*a. syntheta* Dyar and Shannon

KEY TO THE PUPAE OF GENUS *WYEOMYLA*  
 IN THE NEARCTIC REGION<sup>2</sup>

1.         Paddle with fringe of long spicules, paddle  
           strongly tapered apically.....*mitchellii* (Theobald)  
           Paddle without fringe, with at most short  
           spicules, except longer at apex, paddle  
           more rounded or truncate at apex.....2

<sup>1</sup>Modified from Darsie (1950), Belkin and McDonald (1956) and Belkin et al. (1970).

<sup>2</sup>Partially adapted from Darsie (1950) and Belkin, Heinemann and Page (1970).

- 2(1). Abdominal tergum I with mottled brown pattern  
 extending to margins.....*vanduzeei* Dyar and Knab  
 Abdominal tergum I with brown pigment restricted  
 to center between setae 1.....3
- 3(2). Paddle with prominent apical and subapical spicules  
 on inner and outer borders, with double row  
 on outer border, with 5-7 large spicules  
 along truncated apex.....*haynei* Dodge  
 Paddle with small apical spicules along inner and  
 outer borders, very few subapical spicules  
 present, with 12 large spicules along truncated  
 apex.....*smithii* (Coquillett)

As a result of this study, only the pupae of genus *Aedes* and genus *Culex*, subgenus *Culex* remain without proper identification keys. Darsie (1957) produced a key to 27 species of *Aedes*, it contained only 35% of the 77 species of that genus in Nearctica. A study is underway to prepare an identification key for the pupae of *Aedes*, since 70% of the total has now been described and specimens of most of those undescribed are available.

The pupae of the 2 Nearctic subspecies of *Toxorhynchites* are apparently indistinguishable. *Tx. r. rutilus* (Coquillett) was described by Reinert (1970) and *Tx. r. septentrionalis* (Dyar and Knab), by Steffan and Evenhuis (1980).

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